REMARKS

Claims 1 through 34 are pending in this reissue application.

The specification and claims 3, 4, 7 and 9 are being amended and claims 16 through 34 are being newly added.

In view of the foregoing Preliminary Amendment, this reissue application is believed to be in condition for examination. Should questions arise during the examination, the Examiner is requested to contact applicant's attorney.

Respectfully submitted,

Robert E. Bushnell,
Attorney for the Applicant
Registration No. 27,774

1522 "K" Street, N.W., Suite 300
Washington, D.C. 20005
(202) 408-9040

Folio: P54757RE2
Date: 5 October 2001
I.D.: REB/kf

MARKED-UP VERSION OF AMENDMENTS

IN THE SPECIFICATION

1. Please amend the second paragraph at column 1, from line 18 through line 21, as follows:

The present invention relates to a data address mark for a hard disk drive and, more particularly, relates to a method for forming and processing a data address mark for a hard disk drive in order to improve production yield.

2. Please amend the seven consecutive paragraphs bridging columns 1 through 3, as follows:

Hard disk [drive is] drives are widely used as an auxiliary memory device of a computer system because [it] they can access a large amount of data at high speed. Generally, a hard disk drive utilizes a recording form based on constant-track capacity to record and reproduce data to and from a magnetic disk. In this recording form, the hard disk drive rotates at a constant velocity, and information capacity per track of inner tracks of a magnetic disk is the same as that of outer tracks. However, information recording density of the outer tracks is lower than that of the inner tracks because the outer track is substantially larger than the inner tracks. Consequently, the storage efficiency of the magnetic disk is minimal.

One popular technique to increase the information recording density of a magnetic disk is a recording type of constant linear density (CLD) or zone-bit recording. In the constant linear density recording form, all tracks including inner and outer tracks contain the same information density in order to improve the information capacity of the magnetic disk. Moreover, an information recording area of the magnetic disk is split into a plurality of zones so as to have constant recording density in a radial direction from the center of the magnetic disk. The number of data sectors is differently assigned to the tracks of each split zone. That is, the tracks of an outer zone have [the] <u>a</u> number of the data sectors more than the tracks of an inner zone. The data sector designates a unit area for accessing data on the magnetic disk by the hard disk drive and has the same size, 512 bytes for example, irrespective of the position of the magnetic disk. If an embedded sector servo system as disclosed, for example, in U.S. Pat. No. 5,210,660 for Sectored Servo Independent Of Data Architecture issued to Hetzler, U.S. Pat. No. 5,384,671 for PRML Sampled Data Channel Synchronous Servo Detector issued to Fisher, U.S. Pat. No. 5,420,730 for Servo Data Recovery Circuit For Disk Drive Having Digital Embedded Sector Servo issued to Moon et al., U.S. Pat. No. 5,475,540 for Magnetic Data Storage Disk Drive With Data Block Sequencing By Using ID Fields After Embedded Servo Sectors issued to Gold, is used to provide position information [of] <u>for</u> a transducer (head), one data sector may split into two segments according to each area on the magnetic disk. In such an embedded sector servo system, each data track is divided into a servo information area and a data information area which are alternatively provided in a radial direction of the magnetic disk. The servo information area is an area into which servo information is written and provides a servo sector. The data information area is an area into which actual data information

is written and provides a data sector.

[Typical] A typical data sector includes a plurality of identification (ID) regions, data regions and PAD regions serving as intersector gaps therebetween. Commonly, the ID region includes an ID preamble, an ID address mark (AM), a cyclic redundancy check code (CRC) and an ID postamble. The data region includes a data address mark (AM), data and an error correction code (ECC). Generally, in order to read information of the ID region and the data region of the respective data section, the HDD must be synchronized with a clock frequency previously written on the magnetic disk by using the ID sync and data sync. In practice however, the ID preamble requires many bytes that are restrictive for high density HDD application.

Another technique to improve information recording density in hard disk drives in recent years is known as a recording type of headerless sector format as disclosed, for example, in U.S. Pat. No. 5,500,848 for Sector Servo Data Recording Disk Having Data Regions Without Identification (ID) Fields issued to Best et al, U.S. Pat. No. 5,523,903 for Sector Architecture For Fixed Block Disk Drive issued to Hetzler et al., U.S. Pat. No. 5,581,418 for Magnetic Disk Drive Unit Capable Of Determining Data Region Position Of Data Region That Does Not Include Position Identification Data issued to Hasebe, U.S. Pat. No. 5,627,695 for System And Method For Generating Unique Sector Identifiers For An Identificationless Disk Format issued to Prins, and U.S. Patent No. 5,589,998 for Cylinder Address Storage In Multiple Servo Sectors Of A Track issued to Yu. In Best et al. '848, for example, a fixed block architecture sector format that includes information encoded in the servo region of a sector to enable a data recording head to locate and identify a data sector for read and write operations without the need of an ID region. Similarly, Hetzer et al. '903 and Hasebe

'418 each discloses a sector architecture that further includes information contained in electronic storage to enable the data recording head to locate and identify data sectors for read and write operations without using data ID fields. Likewise, Prins '695 and Yu '998 also disclose a disk drive system for determining sector ID of a data sector on a disk without using ID fields in order to maximize disk capacity.

Generally, the servo sector of the HDD using a headerless servo format includes a preamble region for synchronizing with a system clock, a servo address mark (SAM) region for recording a reference pattern for producing various servo timing signals, an index (IDX) region for supplying a single rotation information [of] for the disks, a sector number region for recording a servo sector number, a head number region for recording the head number, a gray code region for recording track information, a servo burst region for the on-track control of the heads and a postamble region. Common servo address mark (SAM) detection [scheme maybe] is disclosed, for example, in U.S. Pat. No. 5,231,545 for Fault Tolerant RLL Data Sector Address Mark Decoder issued to Gold, U.S. Pat. No. 5,442,499 for Method Of Detecting Sector Servo Information In A Disk System issued to Emori, and U.S. Pat. No. 5,544,135 for Fault Tolerant Servo Address Mark For Disk Drive issued to Akin, Jr. et al.

Meanwhile, the data sector [of] for a HDD using a headerless servo format includes a data preamble region, a data address mark, data, an error correction code (ECC) and a data postamble. The data address mark informs that the data is started and provides necessary synchronization when data is recorded on or read from the magnetic disk. Data is the actual digital information stored in the magnetic disk. ECC is an error detecting code for detecting and correcting an error of the data.

The data postamble provides a necessary timing margin after reading the data. Since the ID post amble is adjacent to the data preamble, and the data postamble is adjacent to the ID preamble, they are mixedly used.

In a contemporary HDD using the headerless recording format, if there is occurrence of a defect in a data area, damaged data can be restored by using the ECC. If there is an occurrence of a defect in a data address mark area, however, it is difficult if not impossible to restore the damaged data address mark. As a result, since the data address mark is not detected, data positioned at a rear area following the data address mark cannot be normally accessed. Moreover, if such a data field is over tolerance limits, the HDD needs to be repaired or discarded, thereby losing valuable operational time and financial resources.

3. Please amend two consecutive paragraphs at column 3, from line 20 through line 29, as follows:

Accordingly, it is therefore an object of the present invention to provide a disk drive using a data sector format having a readily accessible data address mark that is suitable for high density recording.

It is also an object to provide a disk drive and a method for forming a data address mark in [plural] a plurality of different recording patterns in a data sector of a magnetic disk and processing the same in order to minimize non-detection of such a data address mark in the data sector.

4. Please amend the first paragraph at column 4, from line 3 through line 11, as follows:

Referring now to the drawings and particularly to FIG. 1, which illustrates a general track sector format of a magnetic disk using constant density recording. As shown in FIG. 1, the track sector format includes two successive data sectors between servo sectors of a magnetic disk with each data sector [is] subdivided into an identification (ID) field and a data field. Header information for identifying a corresponding data sector is written into the ID field. Actual digital data is written into the data field preceded by the ID field.

5. Please amend the third paragraph at column 4, from line 26 through line 44, as follows:

[Data] A data field consists of a data preamble, a data address mark, data, a CRC and a data postamble, as shown in FIG. 3. Meanwhile, the data field of the magnetic disk using a headerless servo recording system is formed as shown in FIG. 4. The data preamble positioned between the ID postamble and a data synchronizing bit provides clock synchronization for the data field during reading and simultaneously provides a gap between the ID field and the data field. The data address mark informs that the data is started and provides necessary synchronization when the magnetic disk driving apparatus reads the data. The data is the actual digital information stored in the magnetic disk. An error correcting code [(EEC)] (ECC) is an error detecting code for detecting and correcting an error of the data. The data postamble provides a necessary timing margin after reading the data.

Generally, since the ID post amble is adjacent to the data preamble, and the data postamble is adjacent to the ID preamble, they are mixedly used.

6. Please amend the two consecutive paragraphs bridging columns 4 and 5, from line 57 at column 4 through line 15 at column 5, as follows:

Turning now to FIG. 5, [which illustrates] a high density hard disk drive HDD constructed according to the principles of the present invention <u>is illustrated</u>. The HDD includes, for example, two magnetic disks 2 and corresponding four transducer heads 4, a transducer head assembly 6 in an E-shape having actuator arms 5 each for supporting a respective pair of transducer heads 4, a preamplifier 8, a read/write channel circuit 10, an analog-to-digital (A/D) converter 12, a track information detector 13, a micro-controller 14, a digital-to-analog (D/C) converter 16, a voice coil motor (VCM) driver 18, a voice coil motor 20, a motor controller 22, a spindle motor driver 24, a spindle motor 26 for rotating the magnetic head 4 across the surface of the disk 2, and a disk data controller (DDC) 28.

Preamplifier 8 is electrically connected to the transducer head assembly 6 for amplifying a predetermined signal read [out] from the disk 2 using the transducer head 4 and transmitting the amplified signal to the read/write channel circuit 10. For the purpose of writing data onto the disk 2, the preamplifier 8 applies encoded writing data transmitted from the read/write channel circuit 10 to a designated transducer head from the magnetic heads 4 to be recorded on the [disk] <u>disks</u> 2. At this time, the preamplifier 12 selects one of the magnetic heads [2] <u>4</u> according to a control signal

generated from a disk data controller (DDC) 28 under the instruction of a micro-controller 14.

7. Please amend the third paragraph at column 5, from line 29 through line 37, as follows:

Track information detector 13 is connected between the read/write channel circuit 10 and the micro-controller 14 for detecting from the RDATA, a track number for the current position of the transducer head 4 and providing the detected data to the micro-controller 14. The DDC 28 is controlled by the micro-controller 14 to record the data received from a host computer via the read/write channel circuit 10 and the preamplifier 8 or to transmit the data read out from the [disk] disk 2 to the host computer.

8. Please amend the last paragraph at column 5, from line 59 through the last line, as follows:

Refer to FIG. 6 which illustrates a detailed format of a data field constructed according to the principles of the present invention. Data address marks are constructed by 2 bytes. During the write operation of each sector, both first and second data address marks are written, and the write operation is not concerned in the generation of an ECC. The two data address marks are respectively distinguished by using different patterns, and [is discriminated] are distinguished by the micro-controller 14.

9. Please amend the first three paragraphs at column 6, from line 1 through line 39, as follows:

For example, the first data address mark is defined as "A1" and the second data address mark is defined as "A2". The 7 most significant bits select any pattern defined as a user pattern and the least significant bit is used for counting the data address mark constructed by 2 bytes. During the read operation of each sector, when only one byte of data address mark is detected among 2 bytes of data address marks, it is regarded as an effective data address mark. That is, if the first data address mark is normally detected, the second data address mark of one byte is skipped and the following information is regarded as data. If the first address mark has a defect, however, the second data address mark is detected. If it is determined [whether] that the second data address mark is normally detected, the following information is regarded as data. Whether the read data address mark is the first data address mark or the second data address mark is distinguished by the recording patterns as previously determined during the write operation. Meanwhile, the micro-controller 14 should provide a masking function for the data address mark.

For example, if only the 7 most significant bits are normally detected at the same time of detecting a data address mark constructed by 8 bits, the micro-controller 14 skips the [number of byte as many] same number of bytes as the number of the least significant bit [remained] remaining, and regards the following information as data. Accordingly, even if there is an occurrence of a defect in a data address mark of one byte, the following data address mark is normally detected, thereby

lowering the possibility of concluding [drive to be] that the drive is faulty due to non-detection of the data address mark. It should be noted here that while the data address mark as described is constructed by 2 bytes, it may be possible to construct the data address mark by 2 or more bytes.

As described above, the present invention has an advantage in that when one of the data address marks recorded with different patterns is normally detected, the data address mark of a corresponding data field is regarded as an effective value in order to maximize production yield of the disk drive due to non-detection of the data address mark.

IN THE CLAIMS

Please amend claims 3, 4, 7 and 9, as follows: and add claims 16 through 43, as listed above:

3. (Amended) The method of claim 2, further comprised of each [of] said data address mark recorded in said different recording locations of said data track being constructed of one byte of information.

4. (Amended) The method of claim 3, further comprised of bits constructing said one byte being utilized for recording said data address mark and for counting the number of a byte of said remaining data address mark.

7. (Amended) A method for forming and processing a data sector comprising an identification field and a data field in a magnetic disk of a headerless servo recording system,

comprising the steps of:

recording a data address mark, during a recording mode, in at least two different locations of said data field immediately preceding a data area containing user data;

detecting said data address mark recorded in said different locations of said data field, during a reading mode, to confirm validity of user data contained in said data area following said data address mark;

when said data address mark recorded in at least one of said different locations of said data field is detected, regarding said [one] data address mark <u>detected</u> as an effective data address mark of a corresponding data area for confirming the validity of user data contained therein; and

skipping a remaining data address mark recorded in said different recording locations of said data track, when said data address mark recorded in said at least one of said different recording locations is detected.

9. (Amended) The method of claim 7, further comprised of each [of] said data address mark recorded in said different recording locations of said data field being constructed of one byte of information.